at least one Josephson junction, each Josephson junction in said at least one Josephson junction formed between a mesoscopic island in the at least one mesoscopic island and the first bank.

Add new claims as follows:

52. (New) The structure of claim 1, wherein a qubit is formed by the first bank, the mesoscopic island and the clean Josephson junction, and wherein each quantum state on the qubit is characterized by a clockwise or a counterclockwise circulating supercurrent.

53. (New) The quantum register of claim 8, wherein a plurality of qubits is formed by the plurality of mesoscopic islands, the bank, and the plurality of clean Josephson junctions, and wherein each quantum state on each qubit in said plurality of qubits is characterized by a clockwise or a counterclockwise circulating supercurrent.

54. (New) The qubit of claim 28, wherein each quantum state on the qubit is characterized by a clockwise or a counterclockwise circulating supercurrent.

55. (New) The quantum register of claim 39, wherein a qubit is formed by each mesoscopic island in the at least one mesoscopic island together with the first bank and a Josephson junction in the at least one Josephson junction, and wherein each quantum state of each said qubit is characterized by a clockwise or a counterclockwise circulating supercurrent.

56. (New) The structure of claim 1, wherein a qubit is formed by the first bank, the mesoscopic island and the clean Josephson junction, and wherein the qubit has a quantum state that is twice degenerate in the absence of an external electromagnetic field.

57. (New) The quantum register of claim 8, wherein a plurality of qubits is formed by the plurality of mesoscopic islands, the bank, and the plurality of clean Josephson junctions, and wherein each qubit in said plurality of qubits has a quantum state that is twice degenerate in the absence of an external electromagnetic field.

58. (New) The qubit of claim 28, wherein the qubit has a quantum state that is twice degenerate in the absence of an external electromagnetic field.

59. (New) The quantum register of claim 39, wherein a qubit is formed by each mesoscopic island in the at least one mesoscopic island together with the first bank and a Josephson junction in the at least one Josephson junction, and wherein each said qubit has a quantum state that is twice degenerate in the absence of an external electromagnetic field.

60. (New) A qubit comprising:

a first bank of a superconducting material having a first crystal orientation;

a mesoscopic island of a superconducting material having a second crystal orientation, wherein at least one of the islands and the bank comprises a d-wave superconducting material;

a clean Josephson junction between the island and the bank, wherein the Josephson junction is configured so that a supercurrent proximate to the Josephson junction alternates between a first ground state having a first magnetic moment and a second ground state having a second magnetic moment by means of quantum tunneling; and

circuitry to allow selective interruption of quantum tunneling between the first ground state and the second ground state.

61. (New) The qubit of claim 60, wherein the circuitry comprises a parity key that connects the island to ground.

62. (New) The qubit of claim 60, wherein the circuitry comprises a single electron transistor that connects the island to ground.

63. (New) A quantum computer comprising the qubit of claim 60 and a readout device for detecting whether the supercurrent has the first magnetic moment or the second magnetic moment.

64. (New) A quantum register comprising:

a bank of a superconducting material;

a plurality of mescopic islands of superconducting material;

a plurality of clean Josephson junctions, wherein each Josephson junction:

is between the bank and a corresponding one of the islands ; and

is configured so that a supercurrent proximate to each Josephson junction alternates between a first ground state having a first magnetic moment and a second ground state having a second magnetic moment by means of quantum tunneling; and

circuitry to allow selective interruption of quantum tunneling between the first ground state and the second ground state of the supercurrent associated with each Josephson junction.

65. (New) A quantum computer comprising the quantum register of claim 64 and a readout device for detecting whether the supercurrent of each Josephson junction has the first magnetic moment or the second magnetic moment.